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ABSTRACT

Effects of embedded (appropriately positioned within text) and intact (outline format) headings on the processing of ecological and geological text material were examined in two separate studies. Suggesting that outlines may provide readers with global information about a passage and that embedded headings may aid in discovering relationships between global information presented in headings (outline) and detailed information in a passage, psychology students (N=132) were assigned to groups comparing effects of: outlines/headings, outlines only, headings only, and control (no outlines/headings). Results indicated that embedded headings improved delayed test performance. The second study focused on instructions for input (tying headings to text material) and output (using headings as cuing devices for recalling text) processing. It was found that psychology students (N=106) assigned to groups using headings/instructions outperformed groups using headings without instructions or no headings/instructions. A discrepancy was observed between the two experiments in that the presentation of headings without instructions failed to significantly increase test scores on dependent measures (essay, outline, multiple-choice) in the second study; sensitization to headings was proposed as one possible explanation. It was also found in the second study that field-independent individuals consistently outperformed field-dependent individuals on dependent measures. (Author/JN)

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Effects of Individual Differences, Processing Instructions, and Outline and Heading Characteristics on Learning from Introductory Science Text

Section 2: The Effects of Author-Provided Headings on Text Processing

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FINAL REPORT

January 1982

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General Summary

A series of experiments were conducted to examine the impact of author-provided and student-generated headings on the recall of 2,500-word excerpts from basic science textbooks. If the students are sensitized to the presence of author-provided embedded headings, the delayed recall is significantly enhanced in comparison to individuals studying text without headings. However, author-provided intact headings (i.e., outlines) did not lead to significant improvements in recall.

Instructing students on using embedded headings to aid in the comprehension, storage, and retrieval of the text information led to even further improvements in delayed recall performance in comparison to groups receiving either no headings or no instructions on using headings. However, limiting instructions to only the inputting or outputting of the text material did not prove to be effective.

Since many texts contain only sparse headings or no headings at all, the impact of students generating their own headings was assessed. This generation activity led to improvements in delayed recall in comparison to either author-provided headings or no headings.

Intermediate between having the students generate their own headings and directly employing author-provided headings is an approach which provides the students with a generalized set of headings (knowledge schema) that can be imposed on a variety of texts. A knowledge schema for scientific theories was created and students were trained in its use as a text processing technique. Two studies indicated that this training led to improved recall

in comparison to students using their normal study methods. In addition text organized according to this schema was recalled better than text organized in a coherent, alternate presentation sequence.

In conclusion, the results of the reported series of experiments suggest that under most conditions author-provided, embedded headings facilitate descriptive text processing. Further, having students generate their own headings or having them impose a general set of categories (knowledge schema) on a body of text appears to result in even more effective text recall. The pragmatic and theoretical implications of these findings are discussed within each section of the report.

This final report consists of descriptions of a series of experiments conducted to examine the role of topic headings (author-provided and student-generated) in text processing. These experiments fulfill the requirements set forth in NIE Grant Number NIE-G-79-0157.

The Effects of Author-Provided Headings

on Text Processing

Abstract

The present article reports two studies concerned with the effects of headings, both embedded and intact (outline), on the processing of complex text material. Results of the first study indicated that embedded headings reliably improved delayed test performance. In the second study it was further found that instructions in the use of headings as processing aids facilitated test performance. A discrepancy, however, was observed between the two experiments in that the presentation of headings without instructions failed to significantly increase test scores on the dependent measures in the second study. Sensitization to the headings was proposed as one possible explanation for the results. The relationship between field-independence and text processing was also investigated in the second experiment. It was observed that field-independent individuals consistently outperformed field-dependent individuals on the dependent measures.

The Effects of Headings on Text Processing

The present article presents two studies concerned with the effects of headings on the processing of complex text material. In general, it may be assumed that headings influence cognitive processing by (1) acting as cues for prior knowledge relevant to a given topic, (2) accentuating the relationships among the concepts and facts in a given text, and (3) providing retrieval cues for subsequent recall. These potential effects of headings appear to be most easily explained within the context of schema theory.

The basic assumption of schema theory (and similar models such as Ausubel's subsumption theory, 1963) is that humans process information in accord with hierarchically inclusive schemata and sub-schemata. A schema is a generic representation (in memory) of an object, concept, idea, or process that contains a number of empty slots or placekeepers. These slots are filled in (instantiated) when the schema is activated (Anderson, 1977). For example, a face schema contains slots for eyes, ears, nose, mouth, etc.; these slots are instantiated when a specific face is encountered (or recalled). Each of these subschemata (e.g., eyes) has its own subschemata with empty slots that can, if needed, also be activated (e.g., a nose schema might include such slots as long, pug, or flat).

Studies by Bransford and Johnson (1973), Schallert (1976), Anderson, Spiro and Anderson (1977), and others have indicated that a disambiguating title (heading) placed before a passage containing relatively familiar material strongly influences comprehension. Until recently most of the work in this area has been directed toward exploring the influence of schemata on comprehension

and and encoding (input). However, several investigators (Bower, 1977; Mandler & Johnson, 1977; Pichert & Anderson, 1977) have speculated that a schema might provide a retrieval plan. The idea is that the memory search would proceed from the generic knowledge incorporated in the schema to the particular information stored when the text was studied. An experiment by Anderson and Pichert (1978) provided evidence that these speculations are correct by showing that on some dimensions recall is increased when a subject is given an appropriate schema prior to recall.

Most studies demonstrating the effectiveness of schemata have been limited to the activation of familiar schemata already existing within the student's repertoire (e.g., "washing clothes," Bransford & Johnson, 1973). However, in dealing with unfamiliar academic material one would not expect students to have coherent schemata already available. In fact, part of the task of learning new material may be conceived of as the acquisition of new schemata. Once partially acquired these new schemata may be important in guiding subsequent processing (i.e., further comprehension, organizing the information for storage, retrieval and responding). Prior work has not systematically explored these acquisition and utilization processes.

In an initial attempt to expand schema theory to the processing of unfamiliar academic prose, two studies were conducted investigating the effects of hierarchical, author-provided intact and embedded outlines (headings) on text learning.

A hierarchical outline can be considered to be a schema for the passage it represents. As such it may serve as the author's communication schema, or as a more general knowlege schema, or both. In any case, the hierarchical nature of the outline communicates the relationships between information presented in different parts of the text.

It should be pointed out that even with unfamiliar material the content of outlines/headings may trigger off prior schemata. However, it would be expected that these schemata would represent bits and pieces from a variety of higher order schemata as opposed to a coherent framework. So, although one might certainly expect some facilitation of performance due to effects on input processes, it seems probable that the effectiveness of schematic cues with relatively unfamiliar material will depend on the acquisition and subsequent usage of the cues in further comprehension, storage, retrieval and responding.

More specifically, it would appear that intact outlines may provide the student with information about the superordinate topics and their interrelationships, but would not necessarily provide ties between the superordinate information in the outline and the subordinate information presented in the text. On the other hand, headings (embedded outlines), by their presence in the text, should provide clear ties between the superordinate and subordinate information but probably do not effectively indicate the interrelationships between superordinate topics (Carver, 1970). Consequently, intact and embedded outlines (Headings) may influence text processing in a complimentary fashion.

Past research on outlines and headings has generally produced mixed results. Early studies examining the effects of intact outlines (e.g., Christensen & Stordahl, 1955; Northrop, 1952) were predominantly negative. Recent research, however, has led to somewhat more positive conclusions concerning their effectiveness. For example, Proger in two related studies (Proger, Carter, Mann, Taylor, & Bayuk, 1973; Proger, Taylor, Mann, Coulson, & Bayuk, 1970) found that presentation of a sentence outline had a greater positive impact on comprehension scores than did a number of other types of supplementary materials. Other studies in this area (Eggen, Kauchak, & Kirk, 1978; Glynn & DiVesta, 1977; Brooks, Dansereau, Holley, & Collins, Note 1) have also offered support for the use of outlines as processing aids for descriptive text.

Previous studies investigating the effectiveness of embedded headings initially produced equivocal results (e.g., Hites, 1954; Klare, Shuford, & Nichols, 1958; Lee, 1965; Robinson & Hall, 1941). In more recent studies positive results have been obtained. Doctorow, Wittrock, and Marks (1978) demonstrated that headings, when used by themselves or in conjunction with instructions to write a one-sentence elaboration of the heading, improve learning of prose material compared to a control group. Additionally, Dee-Lucas and DiVesta (1980) in a recent study indicated that having students generate their own headings facilitated text processing performance. Finally, Holley (Holley, Dansereau, Evans, Collins, Brooks, & Larson, (1981) has investigated the effects of instructing students directly in the use of author-provided outlines and embedded headings as processing aids.

Because the present studies are directly related to the Holley et al. (1981) experiment, a more comprehensive report of that study will be presented here. Two major factors were investigated in this study. The first factor was a training/headings factor which consisted of (1) an input training group (instructions were given to attend to the embedded headings during input processing and to actively attempt to tie the headings to information presented in the text), (2) an output training group (this group was instructed to use the outline as a retrieval device at time of recall), (3) a no training with headings group (this group was told to use their normal studying techniques), and, (4) a no training without headings group (this group served as a control and received instructions to use their normal studying techniques). The second factor was a temporal factor with testing for comprehension/recall occurring either immediately after studying or with a 5-day interval between time of studying and time of testing. In general, the results of this study showed no significant effects for training, but did demonstrate that the presence of headings in text significantly facilitated prose learning. Additionally, the effects due to the presence of headings was greater with delayed testing.

Unfortunately neither this study nor any of the earlier ones have directly compared the effects of headings and outlines used separately and in combination. In addition, most of the past research in this area has been associated with a number of other limitations. As pointed out by Holley et al. (1981) these include (1) the use of short, artificial prose (cf. Rothkopf, 1972), (2) the use of only cued exams such as

multiple choice or cloze as the dependent measures (cf. Carroll, 1971; Carter & Carrier, 1976) and (3) the use of only an immediate testing paradigm (cf. Gagne, 1978).

Study 1

The first study presented addresses each of these limitations, and extends the Holley et al. (1981) experiment. In particular the first study compares the effects of text containing outlines only, headings only, outlines and headings used in combination, and no outlines or headings.

To the best of our knowledge this study is the first direct comparison of headings and outlines as facilitators of prose learning. In this regard, it should be again noted that headings and outlines may have potentially different effects on processing. As mentioned earlier, outlines may provide the reader with global information about the structure of a passage, while embedded headings may aid the reader in discovering the relationships between global information presented in the headings (outline) and detailed information presented in the passage. If these assumptions are correct it would be expected that the headings/outline combination would be the most beneficial since this combination would presumably provide both sources of information.

Method

Participants. One hundred and thirty-two students were recruited from general psychology classes and randomly assigned to the following groups: Outlines and Headings (n=33), studied passages that contained both intact outlines and embedded headings, Outlines Only (n=33), studied passages that contained only intact outlines; Headings Only (n=35), studied passages that contained only embedded

headings, and Control (n=31), studied passages that did not contain outlines or headings.

Stimulus material. Two prose passages covering scientific topics (ecology and geology) were employed in this study. Both of these passages were selected from introductory textbooks and have been utilized in a number of previous experiments (e.g., Dansereau, Holley, Collins, Brooks, McDonald, & Larson, 1980; Holley et al., 1981). Both passages have similar non-content properties (e.g., approximately the same length of 2,400-2,500 words, the same number of headings, the same readability ratings, etc.), and seem to be relatively unfamiliar to the majority of students who in past studies have indicated that less than 20% of the information in the passages is familiar to them.

Passage headings were created by having five judges familiar with each of the passages rate the author-provided headings on a nine-point Likert-type scale (1=very inappropriate, 9=very appropriate), and provide alternatives for those headings receiving a rating less than 7. This procedure was repeated until all proposed headings received a rating higher than 7 from each judge. In addition to this criterion, all headings were restricted to providing information to the reader that was also available in the section of the text following the heading. The intact outlines were formed by listing the headings in a hierarchical format on a single page.

Measures. The Delta Vocabulary Test (Deignan, 1973) which was used as a measure of verbal ability, has been shown to be moderately related ($r \cong .60$) to other measures of verbal aptitude (e.g., Scholastic Aptitude Test). In the current study this measure was used as a covariate.

Three dependent measures were used to assess performance on the two passages. These were: (1) Essay -- Participants were given 17 minutes to write an organized summary of the passage, (2) Outline -- Participants were given a sample outline format and were asked to create an organized outline of the passage (10 minutes), and (3) Multiple Choice -- 28-item test (10 minutes). The multiple choice has been used previously (Dansereau et al., 1980), and has been modified on the basis of item analyses. These measures were selected to reflect the degree to which recall of text information (essay test), recognition of text information (multiple choice test), and knowledge of text structure (outline test) were affected by the experimental manipulations (cf., Dee-Lucas & DiVesta, 1980).

Procedure. All participants filled out consent forms and were administered the Delta Vocabulary Test in the first session. Subsequent to this session participants were randomly divided into four groups. In the second session each participant was given a study and test folder. The study folder contained general instructions and the passage materials (these materials differed according to group assignment; also, approximately half of the individuals in each group received the plate tectonics passage, while the other half received the ecosystems passage). Students studied the materials for 50 minutes and after a 5-minute break filled out the three dependent measures in the test folder (essay, outline, and multiple choice).

The third session occurred 2 days after session 2. In this session participants studied the passage they had not received in the previous session for 50 minutes. During the fourth session,

which occurred 5 days after the third session, the three dependent measures for the second passage were administered.

Because of scheduling difficulties, 41 of the participants completed only sessions 1, 3, and 4, and 6 participants completed only session 1 and 2. These subjects were approximately evenly distributed across the treatment conditions. Thus, the total N for the immediate tests was 96, and the total N for the delayed tests was 121.

Results

All dependent measures were scored according to predetermined keys without knowledge of group affiliation. Interrater reliability for the free recall content scores was assessed by having a second person score a random subset of the exams. A Pearson product-moment correlation was computed and a correlation coefficient of .85 was obtained. This was considered to represent an adequate level of interscorer reliability.

Immediate Test Analyses. The three dependent measures (essay, outline, and multiple choice) were examined using a 3-way multivariate analysis of covariance (MANCOVA) with the Delta Vocabulary Test (Deignan, 1973) as the covariate. The three dicotomous factors used in the analysis were (1) Headings (present vs. not present), Outlines (present vs. not present), and Passages (plate tectonics vs. ecosystems). Since any main effects due to passages were not of interest in the present investigation the dependent scores were converted using a Z transformation (cf., Myers, 1980) in order to evaluate the two passages using an equivalent scale. Additionally, unweighted means analysis was used to adjust for unequal Ns among the eight cells.

The obtained Wilk's Δ and associate $\underline{X}^2$ values for all main and interaction effects were nonsignificant. Means and standard deviations for each of the three separate dependent measures are shown in Table 1.

Insert Table 1 about here

Delayed Test Analyses. Identical procedures were used to analyze the delayed measures as were used for the immediate tests. Tests for the homogeneity of the within-group regression slopes for the covariate were conducted and found to be nonsignificant for all dependent measures, all $\underline{F}$s $(3,112) < .12$, $\underline{p} < .94$. Results of the MANCOVA revealed a significant main effect for the presence of headings, Wilk's $\Delta = .931$, $\underline{X}^2_{(3)} = 7.90$, $\underline{p} \leq .05$, and a significant interaction between the headings and outline factors, Wilk's $\Delta = .883$, $\underline{X}^2_{(3)} = 13.76$, $\underline{p} \leq .01$. Follow-up univariate analyses were computed for each of the separate dependent measures.

A significant main effect was found for the presence of headings for the essay exam, $\underline{F}$ $(1,112) = 5.15$, $\underline{p} \leq .02$, and the outline exam, $\underline{F}$ $(1,112) = 6.41$, $\underline{p} \leq .01$. The obtained $\underline{F}$ value for the multiple choice exam was not significant, $\underline{F}$ $(1,112) = 0.40$, $\underline{p} < .05$. An examination of Table 2 indicates that these effects are due to the headings groups outperforming the no headings groups.

Insert Table 2 about here

The first order interaction for the headings and outlines

factors was significant for the outline exam, F (1,121) = 13.42, $p \leq .01$, and the multiple choice exam, F (1,121) = 4.79, $p \leq .03$. This interaction for the essay test was nonsignificant, F (1,121) = 1.57, $p > .05$. Tukey post hoc comparisons collapsing across the passage factor for the outline exam revealed that the Headings Only group and the Outlines Only group significantly outperformed the Control group ($p \leq .01$ and $p \leq .05$, respectively). No other comparisons were significant. Post hoc comparisons for the multiple choice exam failed to reveal any significant comparisons. An examination of the means in Table 2 indicates that for the outline measure there was also a fairly strong trend for the Headings/Outline group to outperform the Control group (mean difference = .39, Tukey critical value = .57 for .05 alpha level), and for the Headings Only group to score comparatively higher than the Headings/Outline group (mean difference = .56, Tukey critical value = .57 for .05 alpha level). Similar trends were found for the multiple choice exam where the Headings Only group outperformed the Control group (mean difference = .41, Tukey critical value = .54 for .05 alpha level). The Headings Only group also had a higher mean performance on both measures as can be seen in Table 2.

Discussion

The present study investigated the effects of headings and outlines used both separately and in combination on the recall of scientific text. Analyses of the immediate tests failed to find significant effects between the four groups. The lack of findings with these measures suggests that all groups had the passage information available for immediate testing. Consequently it appears that headings and outlines do not strongly

influence the immediate recall of complex text material. These findings also support the Holley et al. (1981) contention that exclusive use of immediate testing paradigms may mask potential findings in this domain.

With respect to the delayed tests, the prediction that the combined Headings and Outline group would perform better on the dependent measures in comparison to the other two treatment groups was not supported. In fact, this group had consistently lower mean scores than did the Headings Only group. One possible reason for these results is that presenting students with both types of aids forced them to divide their attention between the outline and headings. In contrast, the individuals in the Headings Only and Outline Only groups were able to focus exclusively on a single processing aid.

The results for the delayed tests strongly support the use of embedded headings as processing aids. As can be seen from examining the means in Table 2 the Headings Only group consistently outperformed the other three groups on all three of the dependent measures. On the other hand, intact outlines, while still having a positive effect on processing and recall of extended text, are less consistent than headings in producing higher scores on the dependent measures. Since the headings did not significantly improve performance during immediate testing it seems reasonable to conclude that the locus of the heading effect is stronger during storage and/or retrieval stages of learning than on the initial acquisition phase.

As mentioned in the introduction, outlines appear to provide information concerning relationships between the superordinate topics while headings provide information about the relationships between superordinate and subordinate materials. The results of the present study suggest that this latter type of information is more important in facilitating prose processing.

Finally, a number of questions are raised by the present study. For instance, what are the typical cognitive strategies that students use in processing headings? Can these strategies be taught to those students who have not yet acquired them? Are there other more effective strategies besides the ones students typically use that would be more beneficial? The second study in this series was designed to provide a preliminary answer to the last of these questions.

Study II

As mentioned previously, Doctorow, Wittrock, & Marks (1978) assessed the effects of elaboration instructions on text processing, and Dee-Lucas and DiVesta (1980) investigated the effects of having students generate their own headings for text. However, neither of these studies directly attempted to determine the effectiveness of instructions to use author-provided headings in processing descriptive prose. Although the Holley et al. (1981) study described earlier did address this question, effects of processing instructions were not found to be significant. One possible reason for this lack of facilitative instruction effects is that the students were instructed to either use the outline and headings as input

processing aids or to use them as output processing. Instructions for input processing encouraged students to tie the headings to information presented in the text. Output processing instructions encouraged students to use the headings as cueing devices for recalling text. This separation of processing may have allowed the "input" group to store the information effectively but did not give them adequate procedures for retrieving information effectively. The opposite scenario may have occurred with the "output" group. If this were the case, instructing participants on both input and output uses of headings should lead to improved performance. The second study, therefore, attempts to combine these two types of instructions (input and output) to produce an effective text learning strategy for students to use in conjunction with text headings.

Secondarily, the present study is also concerned with individual differences in prose processing. Brooks and Dansereau (Note 2), among others (e.g., Pierce, 1980; Vaidya & Chansky, 1980), have shown that students classified as field independent on the Group Embedded Figures Test (GEFT; Oltman et al., 1971) perform significantly better on a number of processing measures than students classified as field dependent. The present study attempts to replicate these findings and to determine whether there are significant interactions with treatment conditions. For example, it may be the case that field independent readers can more effectively make use of headings than field dependent students since they may be better able to relate the super-

ordinate headings to the relevant subordinate material appearing within the text. Given that headings may represent a schema for a passage, such a result would be in line with a study by Spiro and Tirre (1980) who found that field independent readers were more successful at using higher level prior knowledge (i.e., stored schemata) in processing new text material.

Method

Participants. One hundred and six students were recruited from general psychology classes at Texas Christian University. All participants were randomly assigned to the following three groups: Instructions-plus-Headings (n=31), where students were given instructions on using headings to facilitate the input and output processing of text; Headings Only (n=44), where students studied text material containing headings but did not receive instructions; Control (n=31), where students studied text material that did not contain headings. The Headings Only group had a larger N because this group was used in an ancillary and exploratory study otherwise unrelated to the current experiment.

Stimulus Material. The ecosystems passage used in the initial study was used as the to-be-learned material in the second study.

Measures. The Delta Vocabulary Test (Deignan, 1973) was, as in the first study, used as a covariate. The GEFT (Oltman, Raskin, & Witkin, 1971) was used as an individual difference measure. This test purports to measure field independence-dependence, and has recently been shown to be related to prose processing performance in a number of studies (e.g., Spiro & Tirre, 1980; Brooks & Dansereau, Note 2). The same three dependent measures as in the

first study were again used to assess performance on the ecology passage. To reiterate, these tests consisted of (a) an essay exam (17 minutes) which required students to write an organized summary of the passage; (b) an outline exam (10 minutes) which required students to create an organized outline of the passage; and (c) a multiple-choice exam (10 minutes) which consisted of 28 items.

Procedure. The participants were given the following sequence of experimental sessions:

1. Session 1 (105 minutes) -- Participants filled out consent forms and completed the Group Embedded Figures Test. The three groups were then assigned to separate rooms in order to minimize confusion since the instructions and studying procedures for each group were different. The experimenters rotated amont the three rooms to avoid possible bias due to the presence of any one experimenter. The Instructions-plus-Headings group then received instructions on using embedded headings to facilitate input/storage, and output. These instructions consisted of a checklist of cognitive activities the student should engage in while studying text material. In part, students were asked to (a) develop expectations (based on the headings) about the material in the

passage, (b) understand why each heading was appropriate for its section of text, (c) memorize the headings, and (d) practice using the headings as recall aids. They then practiced these techniques on a 1,500-word passage that described functions of the nervous system. The Headings Only and Control groups received instructions to use their typical study methods in practicing on the nervous system passage. (The Control group studied a version of the passage that did not contain headings.)

2. Session 2 (75 minutes) -- In the second session, two days following the first session, the participants were reminded of the instructions they had received in the previous session, they studied the ecosystem passage for 55 minutes. The Instructions-plus Headings and Headings Only groups studied passages containing embedded headings while the Control group studied identical passages that did not contain headings.

3. Session 3 (60 minutes) -- After a five-day delay from the second session the participants in the third session were again combined into one group and were sequentially administered the three dependent measures (essay, outline, and multiple-choice). This pattern of test administration (recall-then-recognition) has been suggested by Battig (1979).

Results

Each of the dependent measures was scored according to pre-determined keys and without knowledge of group affiliation. Interrater reliabilities for the content scores on the essay exam were assessed by having a colleague score a random subset of the exams. An interrater reliability coefficient of .95 was

obtained, again indicating that the reliability of the scoring system was quite good.

The three dependent measures (essay, outline, and multiple choice) were analyzed using a single factor multivariate analysis of covariance with the Delta Vocabulary Test (Deignan, 1973) as the covariate. Unweighted means analysis was used to adjust for unequal Ns among the groups. A Wilk's Δ value of .697 was obtained with an associate $\underline{X}^2_{(6)}$ of 36.52 which was significant at the .01 level.

Subsequently, univariate analyses of covariance were conducted for each of the dependent measures separately. Prior to further analysis, tests of the within-group regression slopes for each ANCOVA were computed. All tests were nonsignificant, all $\underline{F}s < 1$, indicating that the assumption of homogeneity of within-group regression slopes was not violated.

The univariate analyses revealed significant effects for the essay exam, $\underline{F}\ (2,102) = 4.53$, $\underline{p} \leq .01$, and the outline exam, $\underline{F}\ (2,102) = 19.09$, $\underline{p} \leq .01$. The multiple-choice exam failed to significantly discriminate among the three groups, $\underline{F}\ (2,102) = 0.61$, $\underline{p} > .05$. Tukey post hoc comparisons for the essay test revealed that the Instructions-plus-Headings group significantly outperformed the Control group, $\underline{p} < .01$. No other comparisons were significant. Additionally, none of the Tukey comparisons for the outline measure were significant. Means and standard deviations are presented in Table 3.

Insert Table 3 about here

The relationship of field independence, as measured by the Group Embedded Figures Test, and the treatment conditions was assessed using a regression approach. Separate regressions were computed for each of the three groups on the essay, outline, and multiple-choice exams with scores on the GEFT as the lone predictor (a total of nine prediction equations). The b weights for each of the three groups were compared to see if they significantly differed from one another. No significant differences were found for any of the three measures--essay, outline, or multiple choice. Thus, indicating that there were no interactions between GEFT scores and the treatment conditions on any of the dependent measures (cf., Kerlinger & Pedhazur, 1973).

Consequently, the three groups were collapsed and a single regression equation was computed for each of the three measures. R^2s of .082, .056, and .121 were obtained for the essay, outline, and multiple choice tests respectively. The significance of the regression equations was assessed via an ANOVA procedure. All Fs $(1,104) > 6$, ps $\leq .01$ were rather large, indicating that despite the low R^2s, a significant amount of variance in the three measures was accounted for by the GEFT. The b weights in each case were positive, indicating that individuals designated as field independent scored higher on all three measures than did individuals designated as field dependent.

Discussion

This study suggests that instructing students in how to use text headings as study aids is an effective technique for improving performance on selected recall measures. Specifically, it was

found that students in the instructional condition significantly outperformed students in the Control condition on the essay measure as revealed by post hoc tests of significance. Furthermore, the instructional group, while not necessarily showing significant post hoc differences, did have better mean performance than both the Headings Only and Control groups on all the free recall measures (essay and outline tests).

The fact that the Headings Only group (without instructions) did not significantly outperform the Control group on any of the measures is somewhat puzzling in light of the findings of the first study which showed a relatively strong positive effect for embedded headings without explicit instructions. Although both studies used similar procedures and measures, two procedural changes in the present study may account for the discrepancy between the two sets of results. In the first study, students may have been sensitized to the presence of headings. This sensitization could be due to the participants' receiving both immediate and delayed passages and tests, and/or to questionnaires given to the participants concerning their typical use of outlines and headings. In the second study participants were not exposed to either of these manipulations, and so may not have directed as much attention to the headings as in the previous experiment. The possibility of such sensitizing effects when complex prose material of this type is employed has been suggested by other researchers (e.g., Dee-Lucas & DiVesta, 1980). If this contention is valid, it may be that a primary effect of instructions is to sensitize the student to the presence of headings in text material. Future

studies are now being planned that will take this factor into account.

A secondary purpose of the second study was to determine if field independence interacted with the treatment conditions. Although no significant interactions were observed, the results did replicate earlier studies on text processing (Collins, 1979; Brooks & Dansereau, Note 2) that have found an "across the board" effect for field dependence, with the average score for field independent individuals being higher than for field dependent persons. It may be that students who score as field independent are better able to abstract the important information contained in a text from its accompanying general, "background" material using a process analogous to the one used in identifying a simple geometric figure within a more complex design. If such were the case, then it would seem probable that both processes involve the same underlying cognitive mechanisms.

Summary

Two studies were conducted to assess the effects of intact outlines and embedded headings on the processing of complex, scientific prose material. Results of the first study indicated that (1) embedded headings within the text were effective in improving test performance, and (2) that these effects were stronger at a delayed testing interval (5 days), than at an immediate testing interval (approximately 5 minutes).

The second study was designed to investigate whether or not instructing students in the use of embedded headings as processing aids would further enhance test performance compared to merely

presenting the headings without instruction as was done in the initial study. Results of this study showed a significant and positive effect for instructions on headings use; however, presentation of headings without instruction failed to significantly affect performance as was the case in the first study. These results were somewhat puzzling, and procedural changes between experiment 1 and experiment 2 which may have affected participants sensitization to the passage headings was offered as one possible explanation of these results.

The second study also investigated the relationship between field-independence/dependence and text processing. In general, it was found that while treatment conditions (heading usage) did not interact with field independence, there was a consistent and significant difference among the participants in favor of field independent individuals on the dependent measures.

In conclusion, the present studies support the use of embedded headings as processing aids, and further, the present results suggest that instruction in the use of headings is beneficial. A secondary finding is that field-independent individuals tend to outperform field-dependent individuals on a variety of recall measures.

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Table 1

Immediate Testing

Adjusted Means and Standard Deviations

for Each of the Dependent Measures

GROUP		DEPENDENT MEASURE					
		ESSAY		OUTLINE		MULTIPLE CHOICE	
		Plate	Ecosystems	Plate	Ecosystems	Plate	Ecosystems
Outlines/ Headings Combined	M	0.038	-0.023	0.185	-0.178	-0.202	-0.178
	SD	1.000	0.572	1.117	0.870	0.945	0.927
Headings Only	M	-0.095	0.330	0.003	0.390	-0.177	0.118
	SD	1.195	1.349	1.206	1.119	1.053	1.205
Outlines Only	M	0.027	0.110	-0.102	0.937	0.076	0.440
	SD	1.030	0.937	0.786	0.867	1.095	0.822
Control/No Headings or Outlines	M	0.040	-0.335	-0.071	-0.247	0.301	-0.330
	SD	0.852	1.164	0.879	1.306	0.866	0.962

[a]Means and standard deviations have been adjusted according to the Delta Vocabulary Test and all scores have been converted using a Z transformation.

Table 2

Delayed Testing

Adjusted Means and Standard Deviations

for Each of the Dependent Measures[a]

GROUP		DEPENDENT MEASURE					
		ESSAY		OUTLINE		MULTIPLE CHOICE	
		Plate	Ecosystems	Plate	Ecosystems	Plate	Ecosystems
Outlines/ Headings Combined	M	0.069	0.148	-0.055	-0.094	-0.322	-0.081
	SD	0.917	0.889	0.884	0.812	0.619	0.946
Headings Only	M	0.233	0.229	0.427	0.503	0.348	0.217
	SD	1.026	1.048	0.842	1.156	0.540	0.883
Outlines Only	M	-0.018	-0.057	0.109	0.079	0.145	-0.018
	SD	0.375	0.714	0.917	0.592	0.784	0.872
Control/No Headings or Outlines	M	-0.095	-0.453	-0.326	-0.624	0.001	-0.258
	SD	0.659	0.700	0.624	0.840	0.677	0.885

[a]Means and standard deviations have been adjusted according to the Delta Vocabulary test and all scores have been converted using a Z transformation.

Table 3

Adjusted Means and Standard Deviations

for Each of the Dependent Measures[a]

GROUP		DEPENDENT MEASURE		
		Essay	Outline	Multiple Choice
Instructions/ Headings	M	17.10	24.81	19.48
	SD	4.93	11.09	3.90
Headings Only	M	15.15	15.20	19.48
	SD	4.91	6.70	3.97
Control/No Instructions or Headings	M	13.44	13.50	18.59
	SD	4.36	4.97	3.35

[a]Means and standard deviations have been adjusted according to the Delta Vocabulary Test.